STANDARD SPECIFICATIONS AND CODE OF PRACTICE FOR DESIGN AND CONSTRUCTION OF SURFACE DRESSING

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STANDARD SPECIFICATIONS AND CODE OF PRACTICE FOR DESIGN AND CONSTRUCTION OF SURFACE DRESSING

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STANDARD SPECIFICATIONS AND CODE OF PRACTICE FOR DESIGN AND CONSTRUCTION OF SURFACE DRESSING

1 INTRODUCTION

1.1. This document covers the Specifications and Code of Practice for Design and Construction of single and two-coat Surface Dressing and supersedes the existing five documents on the subject listed below :

1. *IRC:17-1965 "Tentative Specification for Single Coat Bituminous Surface Dressing"*

The Tentative Specification as prepared by the Bituminous Pavements Committee in its meeting held at New Delhi on the 26th March, 1963 was sent to all members of the Council for their comments. The Tentative Specification as adopted by the Bituminous Pavements Committee in their meeting held at Chandigarh in November, 1963 in light of the comments of the members of the Council was approved for publication by the Executive Committee in their meeting held on the 30th September, 1964, and was first published in August, 1965.

2. *IRC:23-1966 "Tentative Specification for Two-Coat Bituminous Surface Dressing"*

The Tentative Specification for two-coat bituminous Surface Dressing prepared by the Bituminous Pavements Committee was approved by the Executive Committee at their meeting held on the 20th August, 1966 and was later approved for publication by the Council of the Indian Roads Congress at their 65th meeting held at Trivandrum on the 3rd September, 1966.

3. *IRC:48-1972 "Tentative Specification for Bituminous Surface Dressing Using Precoated Aggregates"*

This Standard was prepared by the Bituminous Pavements Committee in its meeting held on the 8th September, 1971. It was later approved by the Specifications and Standards Committee and then by the Executive Committee. Finally, it was approved by the Council in their 79th meeting held at Gandhinagar on the 25th November, 1972.

4. *IRC:100-1988 "Tentative Specification for Single Coat Surface Dressing Using Cationic Bitumen Emulsion"*

This Specification was finalised by the Bituminous Pavements Committee in their meeting held at Trivandrum on the 5th December, 1987. Later the document was discussed by the Highways Specifications & Standards Committee in their meeting held at New Delhi on the 25th April, 1988 and was approved by the Executive Committee and the Council in their meetings held on the 26th April, 1988 and the 7th May, 1988 respectively.

5. *IRC:96-1987 "Tentative Specification for Two-Coat Surface Dressing Using Cationic Bitumen Emulsion"*

The Bituminous Pavements Committee finalized this specification at its meeting held at Madras on the 13th March, 1987. The document was considered by the Specifications and Standards Committee in their meeting held on the 23rd April, 1987. Later the document was approved by the Executive Committee and the Council in their meetings held on the 28th April, 1987 and 22nd May, 1987 respectively.

1.2. The Flexible Pavement Committee (personnel given below) constituted a sub-group with Dr. Animesh Das and Prof. B. B. Pandey as its members to revise the above mentioned documents taking into account the current developments in the practice of design and construction of Surface Dressing and prepare a

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consolidated single draft document on "Surface Dressing". The draft prepared by the sub-group was discussed by the Flexible Pavement Committee in their meetings held on 1st September, 2001 and 17th May, 2002. The new Flexible Pavement Committee (constituted in January, 2003) reviewed the draft document in its meeting held on 31st October, 2003 and approved in principle and authorised the group consisting of Shri S.C. Sharma, Dr. L.R. Kadiyali, Prof. S.S. Jain and Dr. Animesh Das to finalise the document and forward the same to the Highways Specifications and Standards Committee.

1.3. The draft document finalised by the Flexible Pavement Committee was considered and approved by the Highways Specifications and Standards Committee in its meeting held on the 10th December, 2004 and by the Executive Committee in its meeting held on 18th December, 2004.

1.4. The Council in its 173rd meeting held on 8th January, 2005 at Bangalore approved the document for publication subject to modification in light of the comments/suggestions given by the participants. The document was modified suitably by Shri S.C. Sharma, Convenor, Flexible Pavement Committee and edited by Shri R.S. Sharma, Secretary, IRC.

1.5. References

The following IRC, IS and BS standards contain provisions, which, through reference in the text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standard indicated below:

No.	Title
IRC:SP:16-2004	Guidelines for Surface Evenness for Highway Pavements *(First Revision)*
IRC:SP:34-1989	General Guidelines about the Equipment for Bituminous Surface Dressing
IRC:SP:53-2002	Guidelines on Use of Polymer and Rubber Modified Bitumen in Road Construction *(First Revision)*
IS 73:	Specification for Paving Bitumen *(Second Revision)*
IS 2386:Part 1:1963	Methods of test for aggregates for concrete - Part 1 Particle Size and Shape
IS 2386:Part 3:1963	Methods of test for concrete - Part 3 : Specific gravity, density, voids, absorption and bulking
IS 2386:Part 4:1963	Methods of test for aggregates for concrete - Part 4 : Mechanical properties
IS 2386:Part 5:1963	Methods of test for aggregates for concrete - Part 5 : Soundness
IS 8887:2004	Bitumen Emulsion for Roads (Cationic Type) - Specification *(Second Revision)*
IS 6241:	Method of Test for Determination of Stripping Value of Road Aggregates
BS 812 (Part 114)	Method for determination of the polished-stone value

2. SCOPE

This Document covers the specification and design of :

a) Single-Coat Surface Dressing and
b) Two-Coat Surface Dressing

Using penetration grade bitumen and cationic bituminous emulsion as binder.

The work shall consist of application of one coat or two coats of Surface Dressing, each coat consisting of a layer of bituminous binder sprayed on a previously prepared base, followed by a cover of stone aggregates rolled in to form the wearing surface to the requirement of these specifications.

The specifications are intended to indicate what is considered to be a good practice for construction of single-coat Surface Dressing and two-coat Surface Dressing and shall apply unless modified by special provisions to take into account unusual conditions.

3. DEFINITIONS

3.1. Surface Dressing

Surface Dressing is a common and cost effective surface treatment used (a) to provide a dust free wearing surface over a granular base, (b) to provide surface impermeability against rain-water percolation into the pavement, (c) to arrest disintegration of the road surface, (d) to provide a non-skid riding surface, and (e) to serve as a renewal coat for periodic maintenance of bituminous surfaces.

The Surface Dressing work consists of application (by spraying using a suitable equipment) of appropriate grade of bitumen/ emulsion on a previously prepared base followed by application of a coat of cover material of appropriate size and grading and well rolled. Surface Dressing does not enhance the structural strength nor does it restore the riding quality of a surface having large surface irregularities.

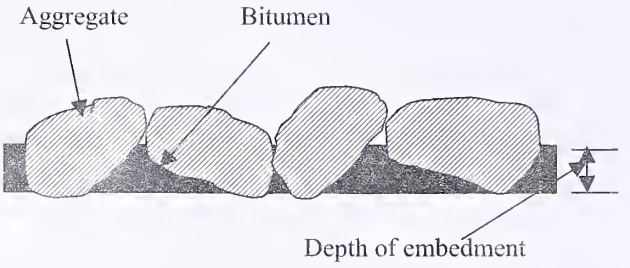


Fig. 1(a) Just after rolling

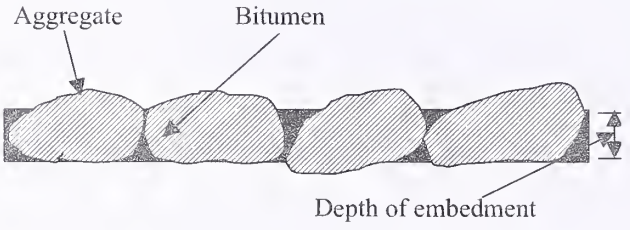


Fig. 1(b) Aggegates and bitumen after rolling and traffic operation in Surface Dressing

Figs.1 (a) and (b) schematically represent a section of Surface Dressing just after rolling and after some traffic has passed. It is seen in the diagram that a part of the aggregate has intruded into the base course.

Since aggregate particles evenly lie on their flattest side, the average thickness of the Surface Dressing is the average of least dimension of the aggregates. This is referred as Average Least Dimension (ALD) of the aggregates (Fig. 2). When aggregates are dropped from a spreader, the voids in the aggregates are about 50 per cent. After the rolling and traffic operations, the air voids drop to about 30 per cent and there is further reduction of air voids to about 20 per cent when exposed to traffic. The thickness of the finished layer approximates ALD. The optimum thickness to

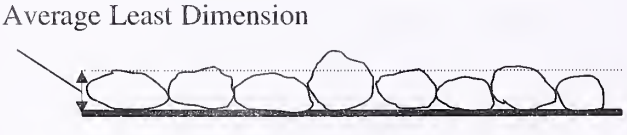


Fig. 2 Average Least Dimension (ALD) of aggregates

which bitumen should rise is about 75 per cent of the average vertical dimension of the aggregates. If the thickness of binder is more than this optimum thickness, it may cause bleeding and make the surface relatively slippery, and if it is less, it may cause loss of aggregates.

3.2. Single-Coat Surface Dressing

The structure is formed by spraying a layer of binder on the previously prepared pavement surface, spreading one layer of cover aggregates and rolling.

3.3. Two-Coat Surface Dressing

The structure is formed by spraying a layer of binder and then spreading of one layer of cover aggregate and rolling, followed by a second layer of binder, spreading of another layer of cover aggregates and rolling. The size of second layer of aggregates is smaller than that of the first layer aggregates.

3.4. Surface Dressing Using Pre-coated Aggregates

This technique is the same as conventional Surface Dressing except that the cover material is aggregates pre-coated with binder.

4. MATERIALS

4.1. Binder

4.1.1. General requirements: The binder shall conform to the requirements as specified and provided for in the proposal and satisfy the related specification, e.g., paving bitumen (Type 1) conforming to IS 73 or cationic bitumen emulsion conforming to IS 8887. The grade of binder to be used would depend upon the climatic conditions. The binder should be fluid enough to permit uniform spraying. After the cover aggregates are rolled into position, binder should be hard enough to hold the particles in position against displacement by traffic.

4.1.2. Paving bitumen: For Surface Dressing using paving bitumen, the binder shall be paving bitumen of a suitable penetration grade appropriate to the region, traffic, rainfall and other environmental conditions as directed by the Engineer-in-Charge. The binder should have a viscosity at the time of application, such that it is fluid enough to permit uniform spraying. The application temperature for the grade of binder used shall be as given in Table-1(a).

4.1.3. Cationic bituminous emulsion: For Surface Dressing using bitumen emulsion, the binder shall be of cationic type bitumen emulsion of appropriate grade (Rapid Setting) and having bitumen content of 65 per cent minimum by weight. The emulsion is said to have set when the water breaks away leaving the black residual

Table 1(a) Spraying Temperatures for Binders

	Spraying Temperature			
Binder penetration grade	Whirling spray jets		Slot jets	
	Minimum (°C)	Maximum (°C)	Minimum (°C)	Maximum (°C)
S-90	180	200	165	175

Table 1 (b) Spraying Temperatures for Binders

	Spraying Temperature			
Binder Bitumen Emulsion	Whirling spray jets		Slot jets	
	Minimum (°C)	Maximum (°C)	Minimum (°C)	Maximum (°C)
Repid Setting	68	80	50	70

bitumen on the surface. The application temperature for the emulsion shall be as given in Table-1(b).

Before opening, the cationic bitumen emulsion drums should be rolled at slow speed, to and fro, for a distance of about 10 metres, 5 to 6 times to mix the contents properly.

4.1.4. Binder for pre-coated aggregates: For Surface Dressing with pre-coated aggregates, binder shall be a paving bitumen of suitable penetration grade. The grade of binder to be used for pre-coated aggregates would depend upon the climate conditions at the construction site.

4.2. Cover Materials (Aggregate)

4.2.1. General requirements: The aggregates shall consist of crushed stone, crushed gravel (shingle) or other crushed aggregates, as specified, and shall have clean, strong, durable, and fairly cubical fragments free from disintegrated pieces, salt, alkali, vegetable matter, dust and adherent coatings. Uncrushed rounded gravel should not be used. The aggregate shall preferably be hydrophobic in nature and of low porosity.

4.2.2. Requirements for cationic-bitumen-emulsion Surface Dressing: The general requirement of aggregates as stated in Clause 4.2.1 shall apply. Additionally, the following points are relevant to the aggregates for Surface Dressing using bitumen emulsion.

Damp aggregates can be used for Surface Dressing with cationic bitumen emulsion and hence when the aggregates are dusty, they shall be cleaned by dipping or washing or by sprinkling water copiously.

Aggregates should preferably be hydrophobic in nature and of low porosity. However, even the

Table 2 Physical Requirements of Aggregates

	Property	Value	Method of test
1.	Abrasion value Los Angeles machine or, Aggregate impact value	Max 40% Max 30%	IS 2386 (Part 4) IS 2386 (Part 4)
2.	Combined Flakiness and Elongation index[1]	Max 30%	IS 2386 (Part 1)
3.	Stripping value[2]	Minimum retained coating 95%	IS 6241
4.	Polished stone value[3]	Min 60	BS 812 (Part 114)
5.	Water absorption[4]	Max 1%	IS 2386 (Part 3)
6.	Soundness: (a) Loss with sodium sulphate - 5 cycles (in case of slag only) (b) Loss with magnesium sulphate - 5 cycles	 Max 12% Max 18%	 IS 2386 (Part 5) - do -
7.	Unit weight or bulk density (in case of slag only)	Min 1120 kg/m3	IS 2386 (Part 3)

Note :

[1]Aggregates having Flakiness index - Maximum 25 per cent may be permitted for low category roads.

[2]When the proposed aggregate fails to pass the stripping test then an approved adhesion agent may be added to the binder in accordance with the manufacturer's instructions. The effectiveness of the proposed anti-stripping agent must be demonstrated by the Contractor, before approval. When cationic emulsion is used refer to Clause 4.2.2.

[3]For high speed roads (NH & SHs).

[4]Except in case of slag.

aggregates having stripping value higher than the permissible limit can be considered for use to the extent of the anti-stripping properties of emulsions, as directed by the Engineer-in-Charge. Because of the very nature, cationic emulsions have better adhesive properties with wet aggregates as well as aggregates having stripping tendencies.

4.2.3. Physical requirements: The aggregate should satisfy the physical requirements given in Table-2.

4.2.4. Grading and size of aggregates: The size of aggregates to be used shall depend on the type of surface over which it is laid and the traffic intensities. Table-3 may be used as a guidance.

For Surface Dressing course, use of single-sized aggregates is recommended. Although a well graded aggregate is usually considered to be the best gradation for compacted asphalt aggregate mixture, it is quite undesirable for Surface Dressing construction because the oversize aggregates are liable to suffer fracture or displacements and the small size aggregates are liable to sink below the bituminous layer. Since with good design and construction practice, the binder rises to only about 3/4th of the average depth of cover aggregates, the tyres are prevented from making direct contact with the binder and also the surface channels between the aggregate particles provide rapid removal of water between the tyre and road surface, reducing the chances of hydro-planning. If same size aggregates are used, tyre gets contact with all of them firmly. This has been pictorially represented in Fig. 3. The recommended

Table 3 Recommended Nominal Size of Aggregates (mm)

Type of Surface	Traffic intensity (Number of Commercial Vehicles with Unladen weight greater than 15 kN) per day in the lane under consideration				
	2000-4000	1000-2000	200-1000	20-200	Less than 20
Very Hard	10	10	6	6	6
Hard	13	13	10	6	6
Normal	19	13	10	10	6
Soft	*	19	13	13	10
Very Soft	*	*	19	13	10

* Unsuitable for Surface Dressing

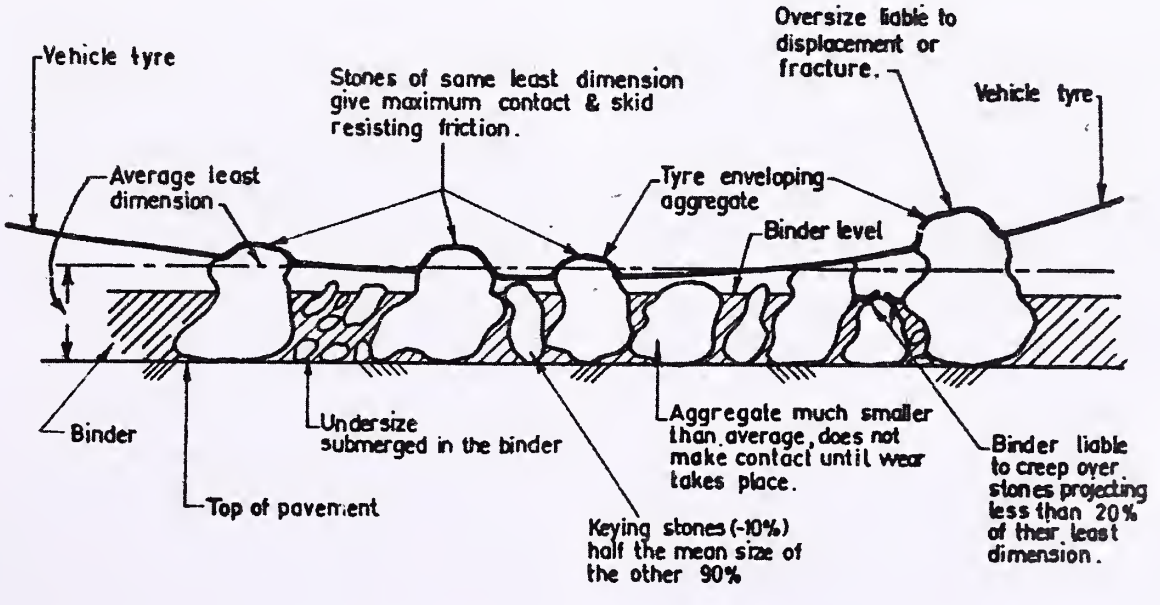


Fig. 3 Effect of using other than single-sized aggregate

Table 4 Grading Requirements for Aggregates used for Surface Dressing

IS sieve designation (mm)	Cumulative per cent by weight of total aggregates passing for the following nominal sizes (mm)			
	19	13	10	6
26.5	100	–	–	–
19.0	85-100	100	–	–
13.2	0-40	85-100	100	–
9.5	0-7	0-40	85-100	100
6.3	–	0-7	0-35	85-100
4.75	–	–	0-10	–
3.35	–	–	–	0-35
2.36	0-2	0-2	0-2	0-10
0.60	–	–	–	0-2
0.075	0-1.5	0-1.5	0-1.5	1-5
Minimum 65% by weight of aggregate	Passing 19 mm, retained 13.2 mm	Passing 13.2 mm, retained 9.5 mm	Passing 9.5 mm, retained 6.3 mm	Passing 6.3 mm retained on 3.35 mm

gradations for various aggregate sizes are given in Table-4. The aggregates shall conform to one of these gradings.

4.2.5. Pre-coated aggregates: As an alternative to use of an adhesion agent the aggregates may be pre-coated before they are spread except when the sprayed binder film is bitumen emulsion. The aggregates shall be pre-coated with 0.75 to 1 per cent of its weight of binder and shall not be pre-coated simultaneously with the paving operation. The aggregates free from dust or fine particles shall be preheated to 160°C for pre-coating and then mixed with binder heated to its application temperature. The aggregate and binder should be thoroughly mixed in a mixer (of approved type) till all the aggregates are uniformly coated. The pre-coated aggregates shall be allowed to cure for at least one week or until they become non-sticky and can be taken out easily from baskets like normal aggregates.

4.3. Quantities

4.3.1. The quantities of aggregates and bituminous binder required will depend on the nominal size of the aggregate and the extent of its embedment into the surface. Approximate rate of application of aggregates, penetration grade bitumen and emulsion required under average conditions are given in Tables 5(a) and (b). Guidance on the design of Surface Dressing and spread rates of aggregates and binder is given in *Appendix*.

5. CONSTRUCTION METHOD

5.1. Weather and Seasonal Limitations

Preferably, the Surface Dressing work shall be carried out when the atmospheric temperature in shade is 16°C or above for penetration grade bitumen and 10°C or above when cationic bitumen emulsion is used. No bituminous material shall normally be applied when the surface or the cover material is damp, when the weather is foggy or rainy or during dust-storm. In the cases where emulsion is used as binder, the work can be carried out when the base is damp but there should be no standing water in depressions.

5.2. Arrangements of Traffic

The road to be treated shall be closed to traffic in length equal to one day's work. Suitable diversions shall be made to divert the traffic. Adequate arrangements of barriers, flags,

Table 5(a) Approximate Rate of Application of Binder[c] Materials and Aggregates for 'non-Pre-coated' Aggregates

Aggregate			Binder	
No.	Nominal size of aggregates mm	Quantity cum/m²	Penetration grade bitumen kg/m²	Emulsion[a] kg/m²
1	19	0.015	1.2	1.8
2	13	0.010	1.0	1.5
3	10	0.008	0.9	1.3
4	6	0.004	0.75	1.10

Table 5(b) Approximate Rate of Application of Binder[c] Materials and Aggregates for Pre-coated Aggregates

Aggregates			Binder[b]
No.	Nominal size of aggregates mm	Quantity cum/m²	Penetration grade bitumen kg/m²
1	19	0.014-0.015	1.0
2	13	0.009-0.011	0.8
3	10	0.007-0.009	0.7
4	6	0.003-0.005	0.6

Notes :

[a]In the case of two-coat Surface Dressing using bitumen emulsion, emulsion quantities for each coat are added together and about 40 to 45 per cent of the total is applied for the first application and the balance for the second application. Field trial may be required to adjust the quantity.

[b]Excluding the quantity of binder required for pre-coating of aggregates.

[c]The suggested quantities of binder application are for Surface Dressing, over existing bituminous surfaces and primed granular bases.

diversionary signs, warning red lights, etc. shall be made for the convenience and safety of traffic. All diversions shall be kept watered so as to prevent dust getting on to the cleaned or painted surface.

5.3. Equipment

All equipment necessary for the proper construction of work shall be on the site of the work in good condition. The description of some of the equipment used for Surface Dressing is given in IRC:SP:34 "General Guidelines about the Equipment for Bituminous Surface Dressing". Spraying and compaction by synchronized equipment may be preferred for better control and uniformity in construction. In this type of equipment, binder and aggregates are spread in a coordinated way. The binder spraying automatically stops if the aggregate spreading ends (or vice-versa) and, therefore, there is no excess binder waiting for the aggregates to be spread. This ensures better quality of construction and subsequent durability in terms of strong binder-aggregate bond.

5.4. Preparation of Base

The underlying surface course on which Surface Dressing is to be laid shall be prepared,

shaped and conditioned to a uniform grade, camber and section as specified. Any depressions or pot-holes shall be properly made up and compacted sufficiently in advance. All pot-holes and depressions shall be filled up with a suitable premix material and rammed or rolled properly and brought to shape. Where the existing surface shows sign of "fatting-up", such portion should be rectified.

The surface should be swept clean free of caked earth and other foreign matter cleaned first with hard brushes, then with softer brushes and finally blowing off with sacks or gunny bags to remove the fine dust. It is important that the surface be dry and thoroughly cleaned immediately before applying the binder. If the base to be treated consists of granular material, a suitable bituminous primer, should be applied uniformly, preferably by a mechanical sprayer. It is preferable to slightly dampen the surface if emulsion is used as binder.

If the base to be covered by the Surface Dressing is an old bituminous surfacing, it shall be swept clean and free from sand, dirt, dust and other loose, deleterious, foreign matter, by means of mechanical vacuum sweepers and blowers, if available, supplemented by hand brooms wherever necessary or by means of wire brushes, small picks, brass brooms, etc., and shall be dry.

Whenever a prime coat is applied on granular surface, no bituminous material shall be applied until the prime coat has thoroughly cured. The edges of the surface to be treated shall be defined by rope lines stretched in position.

5.5. First Coat

5.5.1. General: This Clause describes the application of binder and aggregates for single-coat Surface Dressing, or first coat of the two-coat Surface Dressing.

5.5.2. Application of binder for first coat: After the surface to be treated has been prepared as specified above, the binder heated to appropriate temperature as specified shall be sprayed uniformly over the surface preferably using appropriate mechanical sprayers. During spraying, the ratio between the truck speed and pump revolution speed is held constant, either by automatic control or manually by the operator. Tables 5(a) and (b) give approximate quantity of application of binder per m^2 area of surfacing.

Binder shall be applied to the surface uniformly. It should be ensured that the required rate of spray of binder is achieved right from the starting point and when the work is resumed the binder is not sprayed on the surface of earlier completed work. This can be done by covering, the surface of the completed work with building paper/bitumen impregnated paper for a length to be sufficient for the bitumen distributor (manually controlled) to attain the required rate of spraying. Excessive deposit of bituminous material upon the road surface caused by stopping or starting the sprayer, by leakage or otherwise, shall be immediately removed.

5.5.3. Application of cover material (aggregates): Immediately after the application of binder, clean, dry aggregates (in the case of emulsion, the aggregates may be damp) of the size and quantity mentioned in Tables 5(a) and (b) shall be spread uniformly by means of a mechanical grit spreader so as to cover the coated surface completely with a single layer of aggregates.

5.5.4. Rolling: Immediately after the application of the cover material as described in Clause 5.5.3, the entire surface shall be rolled, preferably by a pneumatic tyred roller, or with a 60 to 80 kN smooth wheeled road roller. The rolling shall begin at the edge and proceed lengthwise over the area to be rolled, lapping not less than one third of the roller tread, and proceed towards the centre. When the centre is reached, the rolling shall then start at the opposite side and again proceed towards the centre. In the super-elevated portions, the rolling should proceed from inner to outer edge. While the rolling is in progress, additional aggregate shall be spread by hand in required quantity to fill irregularities and to prevent picking up of the aggregate by the roller. Rolling shall be continued until the particles

are firmly embedded in the bituminous layer and forms a uniform closed surface. Excessive rolling which results in crushing of aggregate particles, shall be avoided.

5.6. Second coat

5.6.1. General: This Clause describes the application of binder and aggregates for the second coat of the two-coat Surface Dressing.

5.6.2. Time interval between first coat and second coat: Where Surface Dressing in two coats is specified, the second coat should not be applied until the first coat has been opened to traffic for 2 to 3 weeks.

5.6.3. Application of binder: Prior to the application of second coat of binder, the surface shall be cleaned and loose materials and foreign matters removed. After getting the surface irregularities corrected and the surface conditioned to camber and gradient, a second application of binder heated to appropriate temperature shall be uniformly sprayed preferably with a mechanical sprayer at the rate specified in Tables 5(a) and (b). When using cationic emulsion, the aggregates of the first coat are likely to appear loose and unbonded in a few spots. These will get bonded once the emulsion breaks or sets and should not be disturbed.

5.6.4. Application of aggregates: Immediately after application of binder, aggregates shall be spread uniformly preferably by means of a mechanical grit spreader so as to cover the surface completely at the rate specified in Tables 5(a) and (b). While rolling, the surface shall be broomed with a view to ensure uniform spreading of aggregate. After each pass of the roller, depressions should be removed to give a uniform surface.

5.6.5. Rolling for second coat: Soon after the aggregate is spread uniformly, rolling shall be done preferably with a pneumatic tyre roller or with a 60 to 80 kN static roller in the same manner as described in Clause 5.5.4. For Surface Dressing with cationic emulsion, the finishing rolling can be performed on the next day; this helps to give a firm surface.

5.7. Finishing

The surface evenness of the completed work in longitudinal and transverse directions shall be within the limits specified in Table 6. Frequency of Surface unevenness in 300 m length in longitudinal profile shall be within the limits specified in Table-7.

Table-6. Maximum Permissible Surface Unevenness

Type of Construction	Longitudinal profile (Maximum permissible surface unevenness measured with 3-metre straight edge)	Transverse profile (when measured with camber template)
(1) Mechanised	10 mm	8 mm
(2) Manual	12 mm	10 mm

Table-7. Maximum Permissible Frequency of Surface Unevenness in 300 m length in Longitudinal Profile

Type of Construction	Unevenness (mm)	Maximum number of Surface Unevenness	
		NH/SH	MDR and other category of roads
(1) Mechanised	8-10	20	40
(2) Manual	10-12	20	40

The longitudinal profile shall be checked with a 3-metre long straight edge, at the middle of each traffic lane along a line parallel to the center line of the road. The transverse profile shall be checked with a series of three camber template at intervals of 10 metres.

It is emphasized that Surface Dressing by itself cannot remove any undulations present in the base or the surface on which it is applied. It is, therefore, essential that all operations of rectification to meet the requirements set out above be carried out on the receiving surface before the work of Surface Dressing is begun.

For detailed guidance in this respect, reference may be made to IRC:SP:16 "Guidelines for Surface Evenness of Highway Pavements".

5.8. Opening to Traffic

Where paving grade bitumen is employed as the binder, the finished surface shall be opened to traffic on the following day but if in special circumstances, the road is required to be opened to traffic immediately after rolling, speed of the traffic shall be limited to 20 kmh till the following day. When bitumen emulsion is used, the road may be opened to traffic not earlier than 4 hours after rolling and preferably after 24 hours. Controlling of traffic shall be done by some suitable device, such as, barricading and posting of watchman, installation of suitable signs, etc. consistent with safety.

Guidance on the Design of Surface Dressing

A.1. General

The design of Surface Dressing is made to decide about the (i) type of Surface Dressing, (ii) aggregate type and gradation and binder type, and (iii) quantity of binder and aggregate. These are decided based on considerations of (a) availability of materials, (b) relative economy among materials, (c) traffic, e.g., volume, percentage of trucks, permitted speed, (d) operating conditions, e.g., winter maintenance, (e) environmental conditions, e.g., climatic conditions, vegetation, urbanization, and (f) alignment and grade of existing road, etc.

The single-coat Surface Dressing is a versatile treatment and, therefore, it is currently being used for practically all types of traffic conditions. Under heavy traffic conditions, the two-coat Surface Dressing is preferred.

The first step in the design of a Surface Dressing is the selection of the nominal size of aggregates. Large size aggregates are required for soft surfaces or where traffic is very heavy. Small size aggregates are best for hard surfaces or light traffic. Where skid resistance is important large size aggregates should be used.

In selecting the nominal size of aggregate for two-coat Surface Dressing, the size of the aggregates should be selected on the basis of the hardness of the existing surface and the traffic category as indicated in Table 3 under Clause 4.2.4. The nominal size of aggregates for the second coat should be about half the nominal size of that of the first coat.

The assessment of the hardness of the existing road surface may be made on the basis of judgement with the help of definitions given in Table A 1.

The following two methods are used for estimating the rate of application of the rate of aggregate and bitumen. The second method is more elaborate as it takes into account the volume of traffic, condition of the existing surface, climate and the type of aggregates and is recommended.

Table A 1 : Categories of Road Surface Based on Hardness

Category of Surface	Definition
Very Hard	Surfaces, such as, concrete, or very lean bituminous pavements with dry stony surfaces, into which negligible penetration of aggregates will occur even under the heaviest traffic.
Hard	Surfaces into which aggregates will penetrate only slightly under heavy traffic.
Normal	Surfaces into which aggregates will penetrate moderately under medium and heavy traffic.
Soft	Surfaces into which aggregates will penetrate considerably under medium and heavy traffic.
Very Soft	Surfaces, usually rich in binder, into which even large aggregates will be submerged under heavy traffic.

A.2. Method-I

A.2.1 Fig. A 1 presents the voids at various stages of Surface Dressing construction. When the aggregates are just laid, the voids may be assumed to be 50 per cent, after rolling and compaction, reorientation of particles take place and voids become 30 per cent and finally when it is open to traffic the voids become about 20 per cent.

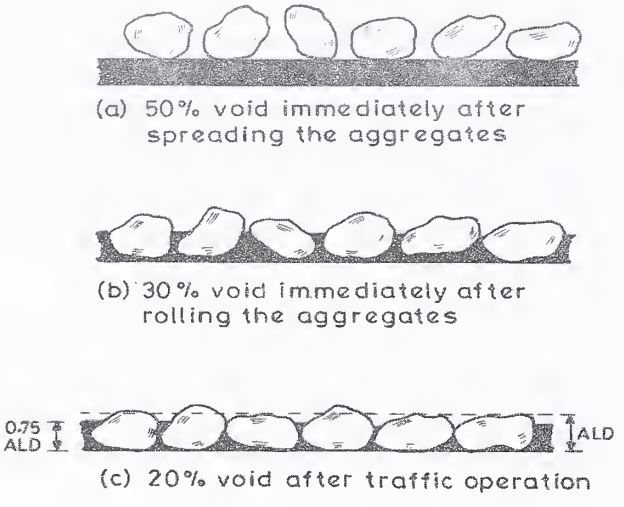


Fig. A 1 Voids at different stages of Surface Dressing construction

Thus the quantity of aggregates required in cubic metres per m^2 of area for laying single-coat Surface Dressing is:

$$\frac{80}{50} \times ALD \times \frac{1}{1000} \qquad ...(1)$$

Where ALD is the average least dimension of aggregates in mm and is determined as per the procedure described in the Clause A.2.2.

10 per cent of the aggregates may be assumed to be lost in whip off due to traffic. Therefore, the correct estimate of required aggregate is:

$$\frac{80}{50} \times ALD \times \frac{110}{100} \times \frac{1}{1000} \qquad ...(2)$$

Completed Surface Dressing where traffic is operational has voids of 20 per cent, out of which bitumen should occupy 3/4th (i.e., 75 per cent) thickness. Thus the quantity of bitumen required in kg per m^2 of area for laying single-coat Surface Dressing is:

$$\frac{75}{100} \times \frac{20}{100} \times ALD \qquad ...(3)$$

However, for the case of Surface Dressing with bituminous emulsion, the binder should occupy upto the level of ALD, because, after evaporation, the level of residual binder will be 3/4th of ALD only (as shown in Fig. A 2).

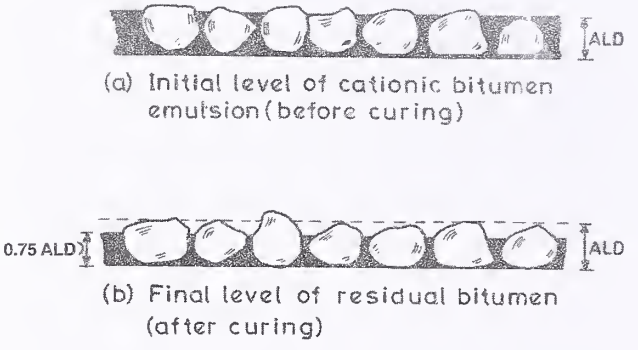


Fig. A-2. Binder thickness using bitumen emulsion

Design of two-coat Surface Dressing is to be done separately for each layer, except that the aggregate size of the second coat must be smaller than the aggregate size of first layer.

A.2.2. Determination of ALD: If the aggregates used for Surface Dressing construction are all of same size and spherical in shape, the ALD will be equal to the median size of the aggregates. However, in reality it is not so. Empirical relationship between the median size, flakiness index and ALD has been presented in Fig. A 3 in the form of a nomograph. The sieve size through which 50 per cent of the aggregates pass is the median size of the aggregates. The flakiness index is found out separately. A line is drawn joining the median aggregate size and the flakiness index to obtain ALD.

A.3. Method-II

This method is more suitable for general application. The design steps are :

1. Select nominal size of aggregates using Table 3.
2. Select type of binder to be used.
3. Determine the ALD of the aggregates.
4. Select factors appropriate to the site of Surface Dressing from the following four Tables for

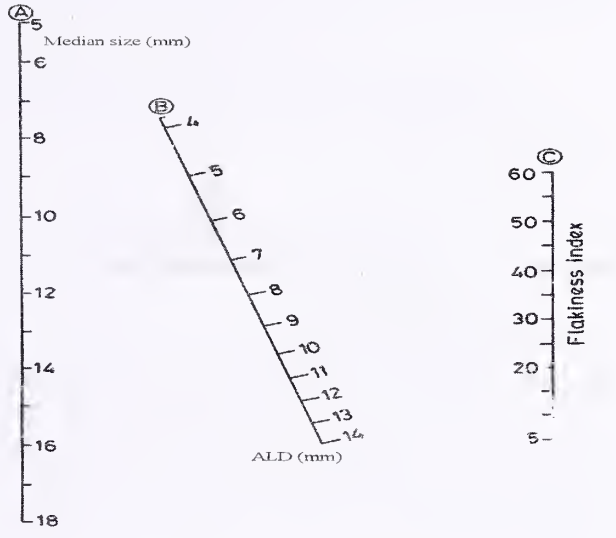


Fig. A 3 Nomograph for determination of ALD

(i) Volume of traffic, (ii) Condition of existing surface, (iii) Climate conditions, and (iv) Type of aggregates.

Add the four factors to determine the overall weighting factor.

(i) Volume of Traffic

	Vehicles/lane/day (Un laden weight greater than 15 kN	Factor
Very light	0-50	+3
Light	50-250	+1
Medium	250-500	0
Medium-heavy	500-1500	-1
Heavy	1500-3000	-3
Very heavy	3000+	-5

(ii) Condition of Existing Surface

	Factor
Untreated or primed base	+6
Very lean bituminous	+4
Lean bituminous	0
Average bituminous	-1
Very rich bituminous	-3

(iii) Climate Conditions

	Factor
Wet and cold	+2
Tropical (wet and hot)	+1
Temperate	0
Semi-arid (hot and dry)	-1
Arid (very dry and very hot)	-2

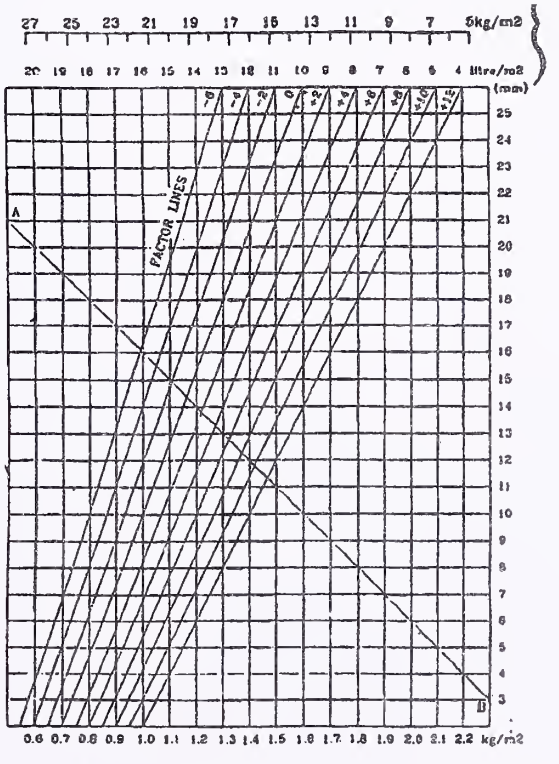
(iv) Type of Aggregates

	Factor
Round/dusty	+2
Cubical	0
Flaky	-2
Pre-coated	-2

For example, if flaky aggregates (factor -2) are to be used at a road site carrying medium to heavy traffic (factor -1) and which has a very rich bituminous surface (factor -3) in a wet tropical climate (factor +1) the overall weighting factor is :

$$-2 -1 -3 +1 = -5$$

5. Determine the design binder and chipping application rates by summing the four factors and entering the value in Fig. A 4. The intersection



*Rate of spread of binder (cutback grades with viscosity greater than 2000 cSt at 60°C)

Fig. A 4 Surface Dressing design chart

part of ALD and the factor line gives the rate of spread of binder (bottom scale).

*1. For slow traffic or climbing grades steeper than 3 per cent, reduce the rate of spread of binder by 10 per cent.

*2. For fast traffic or downgrades steeper than 3 per cent increase the rate of spread of binder by 10 to 20 per cent.

6. The intersection part of ALD and the line AB on the top scale gives the application rate for the aggregates. The aggregates application rate includes a 10 per cent allowance for whip off.

7. The rate of spread of binder is adjusted to allow for the type of binder used. For penetration grade binder, decrease the rate of spread by 10 per cent.

For emulsion, multiply the rate of spread given in the chart by 'Z'

$$\text{where, } Z = \frac{90}{\text{Bitumen content of emulsion (\%)}}$$

8. The aggregates application rate needs to be further adjusted by observing on site whether any extra binder remains after spreading, indicating too low a rate of application, or whether there is overlapping of aggregates, indicating too high an application rate.

(The official amendments to this code would be published by the IRC in its periodical,'Indian Highways', which shall be considerd as effective and as part of the code/guidelines/manuals, etc. from the Date specified therein)